INTERNATIONAL BULLETIN
OF
BACTERIOLOGICAL NOMENCLATURE
AND
TAXONOMY

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## NEWS AND NOTES

Appointment of Professor Torsten Wikén as Secretary for Non-Medical Microbiology. Dr. Torsten Wikén, Professor of Agricultural Bacteriology and Fermentations, Federal Institute of Technology, Zürich, Switzerland has been designated Secretary for Non-Medical Microbiology for the International Committee on Bacteriological Nomenclature. Dr. Wikén becomes also ex officio a member of the Judicial Commission and of the Editorial Board of the INTERNATIONAL BULLETIN OF BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY. Dr. Wikén replaces Dr. R. S. Breed whose resignation was announced in the January number of the BULLETIN.

Curriculum Vitae

Professor Torsten Wikén was born in Söderhamn, Sweden, on August 8th, 1912. He studied botany, chemistry and zoology at the University of Uppsala. He was assistant at the Limnological Laboratory in Aneboda (University of Lund) 1931-1935 and at the Institute of Medical and Physiological Chemistry in Uppsala 1933-1938. From 1938 to 1940 he was associate professor of general chemistry in the Medical Faculty of the University of Uppsala. During 1946-1947 he was associate professor of plant physiology and anatomy at the same university. In 1947 he was appointed professor of agricultural bacteriology and fermentations at the Swiss Federal Institute of Technology in Zürich, Switzerland. He studied physiological microbiology in the laboratories of Prof. E. Melin (University of Uppsala), Prof. A. J. Kluyver (Institute of Technology at Delft, Holland), Prof. C. H. Werkman (Iowa State College, Ames, Iowa, USA.) and Prof. H. A. Barker (University of California, Berkeley, California USA.). Prof. Wikén has carried on researches with the methane bacteria and with the clostridia, with vitamin assay organisms, on production of antibiotics by fungi, on the physiology of wine yeasts, on the use of radioactive and heavy carbon in the field of fermentations, on the technics for study of the anaerobic bacteria, etc. In the fields of nomenclature and taxonomy he is particularly interested in the clostridia and the yeasts.

Organization of the Canadian Society of Microbiologists (Société Canadienne des Microbiologistes). The Canadian Society of Microbiologists was organized at a general meeting held in Ottawa, Ontario, June 7-8, 1951. It has a present membership of more than two hundred. This new Society replaces the "National Committee" which functioned for some years in facilitating Canadian representation in the Permanent International Com-

mittee for the Organization of Congresses of the International Association of Microbiologists and in making nominations of Canadians to membership in the International Committee on Bacteriological Nomenclature and Taxonomy. The officers of the Society are as follows:

President:
Prof. R.G.E. Murray, University of Western Ontario, London, Ontario

Vice-Presidents:
Prof. M.G. Panisset, Institute of Microbiology and Hygiene, University of Montreal, Montreal, Quebec
Dr. A.G. Lochhead, Division of Bacteriology, Science Service, Department of Agriculture, Ottawa, Ontario.

Secretary-Treasurer:
Dr. N.E. Gibbons, Division of Applied Biology, National Research Council, Ottawa, Ontario

Council:
12 members divided amongst the various fields, as indicated:

(Agriculture)
Dr. H.L. Berard, Director Dairy School, St. Hyacinthe, Quebec
Prof. N. James, Dept. of Bacteriology, University of Manitoba, Winnipeg, Manitoba
Prof. E.H. Garrard, Dept. of Bacteriology, Ontario Agricultural College, Guelph, Ontario

(Medical)
Dr. M. Saint-Martin, Bacteriologist, Quebec Ministry of Health Labs., Montreal, Quebec
Dr. C.E. van Rooyen, Connaught Labs., Toronto, Ontario

(Veterinary)
Dr. R. Gwatkin, A.D.R.I., Hull, Quebec

(Parasitology)
Dr. A.M. Fallis, Dept. of Parasitology, O.R.F., Toronto, Ontario

(Mycology, Botany and Plant Pathology)
Dr. G.A. Ledingham, Director, Prairie Regional Lab., National Research Council, Saskatoon, Saskatchewan
Mr. I.L. Conners, Section on Plant Disease Survey, Science Service, Ottawa, Ontario

(Industrial)
Mr. A.D. Bailey, Chief Bacteriologist, Canadian Breweries, Ltd., Toronto, Ontario
Mr. R.D. Henderson, Microbiological Development Lab., Merck and Co., Valleyfield, Quebec

(Microbiological Chemistry)
Dr. J.H. Quastel, Research Institute, Montreal General Hospital, Montreal, Quebec

## BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY

Appointment of Prof. Giuseppe Penso as Secretary-General pro tempore of the International Association of Microbiologists. Prof. Giuseppe Penso, Istituto Superiore di Sanita, Rome, Italy, has been designated as Secretary-General of the International Association of Microbiologists. In a letter addressed to the chairmen of the several national microbiological societies he asks for suggestions relative to the revision of the constitution of the International Association in preparation for the sixth International Microbiological Congress to be held in 1953. He notes that the following constitute the committee on constitutional revision: - Sir Alexander Fleming, London; Professor O. da Fonseca, Rio de Janeiro, Brazil; Professor A. J. Kluyver, Delft, Holland; Professor S. Mudd, Philadelphia, Pennsylvania, U.S.A. and Prof. G. Penso, Rome, Italy.

The Sixth (Rome) International Microbiological Congress, September 6-12, 1953. Secretary-General Penso of the International Association of Microbiologists has announced that the Sixth International Congress for Microbiology of the International Association of Microbiologists will be held in Rome, Italy, September 6-12, 1953. A preliminary program of the Congress is to be issued in the near future.

Meetings of the Judicial Commission of the International Committee on Bacteriological Nomenclature. The Judicial Commission will hold a series of meetings immediately preceding the beginning of the Sixth International Microbiological Congress. At these meetings will be considered all reports and recommendations to be submitted to the International Committee on Bacteriological Nomenclature.

Judicial Commission and International Committee Alternates. Members of the Judicial Commission and members of the International Committee on Bacteriological Nomenclature who will not be in attendance at the meetings of these organizations immediately preceding the Rome Congress September 6-12, 1953 should take appropriate steps for the designation of alternates to act for them. These appointments of alternates should be confirmed to one or other of the Permanent Secretaries, Dr. S. T. Cowan or Prof. Torsten Wikén.

INTERNATIONAL BULLETIN

## CONSERVATION OF THE GENERIC NAME BACTERIUM AND THE FAMILY NAME BACTERIACEAE

Earle K. Borman

January 22, 1952

Dr. Robert S. Breed
Geneva, New York
Dear Dr. Breed:

In a previous letter I filed certain objections to Opinion No. 4 of the Judicial Commission of the International Committee on Bacteriological Nomenclature of the International Association of Microbiologists as set forth in the INTERNATIONAL BULLETIN OF BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY, 1 (4): 145-146 (October 30, 1951). I am again writing to the Permanent Secretaries identical letters which are both a restatement and an amplification of the views expressed in the previous letter. I request that the opinions and arguments which follow be laid before the full Committee in preference to the rather sketchy presentation in my letter of November 30, 1951. The views expressed herein are my own but I feel certain that strong support for them will be found among American bacteriologists.

In considering the opinion, let us refer to that portion which conserves the generic name Bacterium Lehmann and Neumann 1896. The remarks which follow refer either to the opinion or to the Preliminary Statement, File No. 5, of the Judicial Commission (International Bulletin of Bacteriological Nomenclature and Taxonomy 1 (2): 16-31. (April 15 1951).

The Commission first had to consider whether or not Bacterium Ehrenberg 1828 should be conserved or rejected. This earliest use of the name was validly published since a type species, B. triloculare, was indicated by monotypy. The legitimacy of this species has been attacked on the grounds that it is now unrecognizable and no evidence has been brought forth which would aid in its recognition. Therefore, the Commission has ample grounds for rejecting Bacterium Ehrenberg as a nomen dubium which under the International Bacteriological Code of Nomenclature should be retained on the list of nomina rejicienda until evidence can be submitted to the Judicial Commission which clarifies the status of Bacterium triloculare (an unlikely possibility).

Having rejected Bacterium Ehrenberg, the Commission could proceed to consider the status of other generic names including homonyms which might otherwise be regarded as later synonyms. In considering the problem, validly published generic names covering species included in the genus Bacterium by Lehmann and Neumann should have been reviewed in turn. The Preliminary Statement (File No. 5) takes up the cases of the several homonyms published prior to 1896 and disposes of them effectively. It also refers briefly to Serratia Bizio 1823 as a name which might raise a nomenclatural problem but nowhere presents any argument to support or deny the validity or legitimacy of that generic name. Yet

the genus Bacterium Lehmann and Neumann 1896 may be regarded as superfluous since it included a species Bacterium prodigiosum synonymous with Serratia marcescens Bizio 1823. It seems that here the Commission has voted an exception to Rules 19 and 24 of the Code. It is also pertinent that the Commission has voted a similar exception with regard to Klebsiella Trevisan 1885 because Bacterium pneumoniae, a later synonym of Klebsiella pneumoniae (Schroeder) Trevisan, was included in the Lehmann and Neumann genus Bacterium. The same may be said with regard to the genus Proteus Hauser 1885 and to the genus Pseudomonas Migula 1894 because of the inclusion by Lehmann and Neumann of Bacterium vulgare (Proteus vulgaris) and B. pyocyaneum (Pseudomonas aeruginosa). It seems that application of the Code makes the genus Bacterium Lehmann and Neumann superfluous and therefore illegitimate on one count after another. Surely this means that the Commission must have had some compelling reason, of extraordinary scientific importance, for their decision to conserve the genus in question. This reason (or reasons) has not been stated.

Thus, one effect of Opinion No. 4, whether or not such was the intent of the Commission, will be to restrict taxonomists to certain pathways regardless of where their understanding of relationships among the organisms concerned would otherwise lead them. The Commission has not gone to extremes in this matter, to be sure. For example, it has not characterized Serratia Bizio, Klebsiella Trevisan, Proteus Hauser or Pseudomonas Migula as Nomina rejicienda, in effect authorizing a "conservative" group at one extreme to so regard those genera, and another group, perhaps regarded as radicals by implication, to utilize those genera provided none of them are considered broad enough to include Bacterium coli (Migula) Lehmann and Neumann 1896. It would even seem inappropriate to utilize the names referred to as subgenera under the genus Bacterium since that would constitute an exception to Rule 19.

At this point an inconsistency in the Commission's position is apparent. There is considerable evidence to indicate that Klebsiella Trevisan and Aerobacter Beijerinck are too closely related to regard them as separate genera. There is equally weighty evidence linking in a similar manner Escherichia Castellani and Chalmers with Aerobacter Beijerinck. It is a logical approach to the taxonomic problem involved to consider grouping these into one genus. In that case Bacterium coli (Escherichia coli; Colobactrum coli) would be included so that Opinion No. 4 would require that the name Bacterium be used for the genus and that the type species be B. coli. Thus, the generic name Klebsiella Trevisan 1885 which would otherwise have priority under the Code for the genus must be rejected for use in such a case so that it would become unofficially but nevertheless effectively a nomen rejiciendum under those circumstances.

The Opinion would also invalidate the genus Colobactrum Borman, Stuart and Wheeler 1944 which was proposed in anticipation of nomenclatural controversies attendant upon a grouping together of the forms discussed above. There seems no doubt that the Commission by its action must include this proposed generic name on the list of nomina rejicienda in addition to the names Escherichia, Enterobacter, Colibacterium and Enterobacterium. To this I strongly object preferring to have the proposal considered on its own merit rather than by indirection.

These and other considerations lead to the following objections to Opinion 4:

1. Four generic homonyms of questionable legitimacy (Bacterium Ehrenberg 1828, Bacterium Cohn 1872, Bacterium Migula 1894 and Bacterium Lehmann and Neumann 1896) have been reviewed and one of them conserved without adequate review of the choices offered by the availability of other validly published names for the genus in question.

2. Conservation of the homonym Bacterium Lehmann and Neumann involves making the same exception to Rules 19 and 24 of the Code at least four times in passing over the availability and priority of the names, Serratia, Klebsiella, Proteus and Pseudomonas in that order.

3. No compelling scientific reason for so many exceptions has been advanced.

4. Many bacteriologists, who cannot accept the genus Bacterium Lehmann and Neumann sensu lato because it does not satisfy the present need for a more definitive taxonomic concept, are likewise unwilling to accept it in a more restricted sense because the name has been "vulgarized" by the uses to which it has been put both prior to and since Lehmann and Neumann, including its adoption in the Bergey's Manual as a genus of convenience for taxonomically troublesome forms for which an ultimate and more satisfying disposition is of no immediate importance.

5. The circumscription of the genus Bacterium given by Lehmann and Neumann is too broad and indefinite to be useful today; it has stimulated and will continue to invite emendation after emendation, continuing and intensifying the undesirable nomenclatural cleavage that now pertains.

6. The opinion is so sweeping and final that it will vitiate past efforts and stifle future efforts to reach broader international agreement on nomenclature and taxonomy of the organisms under discussion.

I request that this letter be given consideration by the International Com-

mittee and that the contentions contained herein be constructed as a plea that the Committee reject Opinion 4 of the Judicial Commission with or without instructions to review the matter more critically. To the end that further discussion and interchange of views may be evoked, I am requesting the editor of the INTERNATIONAL BULLETIN to print this communication in an early issue.

Earle K. Borman, Assistant Dir.
Bureau of Laboratories
State Department of Health
Hartford, Connecticut, U.S.A.

## ORTHOGRAPHIC ERRORS AND ORTHOGRAPHIC VARIANTS

### III Variants Arising from Use of Different Connecting Vowels and Stems

### Proposals to Amend Rule 27 of the International Bacteriological Code of Nomenclature

### Preliminary Statement (Concluded)

Orthographic variants in formation of compound names of taxa may arise through the use of different connecting vowels and through the use of different stems or combining forms derived from the same root.

Orthographic variants arising from use of different connecting vowels in compound words.

Recommendation 27h states:- "In the formation of names or epithets composed of two or several roots taken from Latin or Greek, the vowel placed between the two roots becomes a connecting vowel, in Latin usually i, in Greek usually o. When the second root begins with a vowel and euphony requires, the connecting vowel should be eliminated. The connecting vowels ae should be retained only where this is required for etymological reasons. In certain compounds of Greek words, no connecting vowel is required, e. g. brachycarpus and glycyphyllus."

Note 2, Rule 27 reads, "The use of a wrong connecting vowel or vowels or the omission of a connecting vowel in a specific epithet or in the name of a genus is treated as an unintentional orthographic error which may be corrected."

The problems may be discussed under three headings, orthographic variants arising from use of different connecting vowels (1) in Latin compounds, (2) in Greek compounds and (3) in nomina hybrida.

(1) Orthographic variants arising from use of different connecting vowels in compounds derived from Latin.

Recommendation 27h is explicit in the statement that the connecting vowel in Latin compounds should be i, and Note 2 of Rule 27 equally clear that errors should be corrected. These recommendations agree with those of the Botanical Code. An examination of the names of the higher microbiological taxa reveals relatively few compounds derived from the Latin. Somewhat larger numbers of such compounds are to be found in specific epithets. Surprisingly, many of these Latin compounds have o rather than i as the connecting vowel. The following examples will illustrate. In a partial compilation of Latin compounds used in microbiology (bacteriology, mycology, algology, virology, protozoology) with the combining form alb-(from albus) as the first component, 117 in all, 24 were

found to have the connecting vowel i and 93 the connecting vowel o. In the index of Bergey's Manual of Determinative Bacteriology (Ed. 6), of the specific epithets listed, one only, albilineans has the connecting vowel i, and eleven have o; ater = black appears twice as atro-; aureus = golden twice as aureo-; flavus = yellow twice as flavi - and ten times as flavo-.

Harper's Latin Dictionary (edited by Lewis and Short) lists 6 compounds with albi- and two with albo-. One of the latter, albogilvus, is the prototype of the large number of Latin compound adjectives that relate to color and that have o as the connecting vowel. No special or serious problems have arisen in nomenclature as a result of the general ignoring of the provisions of Recommendation 27h, and certainly relatively few corrections have been made under the provisions of Note 2. The need for the latter may be questioned.

Draft Recommendation. In the formation of compound names of taxa and of specific epithets from the Latin the preferred connecting vowel is i. Such compound names differing in spelling only by having the connecting vowel i or o are (are not) to be regarded as orthographic variants. Names of taxa which are such orthographic variants and based upon different types are (are not) to be regarded as homonyms. The spelling used for each taxon or specific epithet should be that used by the author when the compound was validly published.

(2) Orthographic variants arising from use of different connecting vowels in compounds derived from Greek.

The Greeks formed many compound words. The rules for making such compounds were somewhat more complex than would be expected from a reading of Recommendation 27h which stresses the use of the connecting vowel o. This rule in classical Greek applied only to compounds in which the first component was a noun (substantive) or an adjective, not to those in which the first component was a preposition, adverb or inseparable prefix. Furthermore, as noted in Recommendation 27h, "In certain compounds of Greek words no connecting vowel is required e.g. brachycarpus and glycyphyllus." Exceptions of this type seem in general to be compounds in which the first component is an adjective with the neuter nominative ending in υ, as γλυκύ = glycy, sweet; βραχύ = brachy; short; πολύ = poly, many, also nouns ending in υ as ἄστυ = asty, city.

Some special exceptions may be noted as from κορύνη = coryne = club was derived κορυνηφόρος = corynephorus = club-bearing, and from this precedent we have the modern Corynebacterium, and in strict conformity with the recommendation an orthographic variant, Corynobacterium. In cases in which there is good classic precedent names

may well be accepted even with a combining vowel other than o.

Draft Recommendation. The combining vowel in Greek compounds in which the first component is a noun (substantive) or adjective is usually o. It may be omitted if the second component begins with a vowel. It is omitted when the first component ends in y, e.g. glycyphyllus. Another combining vowel may be used if there is good Greek precedent, e.g. as in Corynebacterium. Names of taxa or of specific epithets which are Greek compounds and differ only in the presence or absence of the combining vowel o, or have another combining vowel, are (are not) to be regarded as orthographic variants. If the names are based upon different types they are (are not) to be regarded as homonyms. The correct spelling is that used by the author of the name in its initial and valid publication.

(3) Orthographic variants arising from use of different connecting vowels in nomina hybrida.

Both bacteriological and botanical codes contain a recommendation that compound generic names made by combining words of different languages (nomina hybrida) should be avoided. Recommendation 5a of the Bacteriological Code reads, "Bacteriologists who are forming new generic or subgeneric names should attend to the following recommendations:- (5.) Not to make names by combining words from different languages (nomina hybrida)."

It is interesting to note that there is no such recommendation in either the botanical or the bacteriological code relating to the formation of specific or subspecific epithets from words of two languages. The reason for this omission is not clear.

Latin-Greek and Greek-Latin hybrid generic names are common in bacteriology. The following nomina hybrida generica are recognized in the sixth edition of Bergey's Manual: Thiobacillus, Acetobacter, Zymosarcina, Flavobacterium, Malleomyces, Actinobacillus, Fusobacterium, Siderocapsa, Thiosarcina, Thiocapsa and Cristispira (?).

There is no provision in any code of nomenclature authorizing the remodeling of such nomina hybrida. They do not cause serious confusion except when they appear as alternative spellings. Obviously no recommendation as to a suitable combining vowel can be made. However, it may be noted that in the examples quoted the combining vowel in each case is o.

Draft Recommendation. Compound words derived from two or more languages (nomina hybrida) shall (shall not) be regarded as orthographic variants if they differ only in the combining vowel. If two

are names of taxa having different types they should (should not) be regarded as homonyms. The spelling first used by an author in the valid publication of a name should govern.

### Orthographic variants arising from use of different combining forms or stems of the same word

There are several categories of these variants. The most important are derived from words, usually Greek, which in composition show two stems. The largest single group of these is that of Greek neuter nouns which in the nominative end in -μα= -ma and in the genitive in -ματος= -matis. Buck and Peterson (1) list about 3300 such Greek words. Clements (2) after a detailed study of the problem, advised that the proper stem or longer form is to be preferred.

The compounds and derivatives of ἅιμα , ἅιματος =haema, haematis may be used to illustrate. The Greeks used both haem- and haemat as the combining form. One finds in the index of the sixth edition of the Bergey Manual the form haemato- 3 times, haemo- 8 times, and the alternative transliteration, hemo- 6 times. It is evident that in bacteriology the shortened form is the more commonly used for the first component of the compound word.

It may be well to recommend the use of the longer combining form in all words in which there is not already good Greek precedent for the use of the shorter. But the employment of the shorter form apparently causes no confusion, and there is no need of correction. What should be the answer when two words are derived from the same Greek nouns, the first of them from neuter ending in -ma, one of the words using the shortened and the other the full stem? Should none, for example, recognize two generic names Haematococcus and Haemococcus as distinct or as orthographic variants; and, if based upon different types, should they be regarded as homonyms? It would seem that least confusion will follow if the two names are regarded as distinct. What has been said applies particularly to compounds in which a combining form with two spellings is used as the first component. When the combining form is the last component of a generic name, the shortened form should not be used in the formation of the names of higher taxa if serious confusion is to be avoided. A family name derived from Spironema would be Spironemataceae, not Spironemaceae.

Draft Recommendation. In the formation of compound names or specific epithets from words (particularly Greek words) which increase in the genitive, it is preferable to use the longer stem unless there is good Greek precedent for the use of the alternative stems or combining forms are (are not) to be regarded as orthographic variants. If based upon different types they are (are not) to be regarded as homo-

nyms. However, when the word constitutes the final component of a generic name, the longer stem should be used in the formation of the names of higher taxa; if the shorter stem has been used the spelling should (should not) be corrected.

## REFERENCES

1. Buck, C. D. and W. Peterson. A Reverse Index of Greek Nouns and Adjectives. U. of Chicago Press. 1945.
2. Clements, F.E. Greek and Latin in Biological Nomenclature. University Studies. U. of Nebraska, 3:1-84. 1902.

BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMY

## CONSERVATION OF THE GENERIC NAME RICKETTSIA AND OF THE SPECIFIC EPITHET PROWAZEKII IN THE SPECIES NAME RICKETTSIA PROWAZEKII

Request for an Opinion.
File no. 39

Cornelius B. Philip, Public Health Service,
Rocky Mountain Laboratory, Hamilton, Montana, U.S.A.

To the Judicial Commission:-

1. Stricheria jürgensi Stempel 1916 (Deutsch. Med. Wchnschr. 42:439-442, 13 April, 1916) was a validly published binomial. The description combined the proposal of a new species and a new genus. This article appeared in an available journal under the title "Ueber einen als Erreger der Fleckfiebers verdächtigen Parasiten der Kleiderlaus" (On a parasite of the clothing louse suspected as the cause of typhus fever). The illustrated context leaves no doubt that the intra-cellular organism reported in the human body louse and presumed to cause typhus fever in man was as adequately described, considering the laboratory methods available at that time, as was the following species. A check of the names previously proposed in botany and in protozoology fails to reveal any prior use. The generic name Stricheria would therefore seem to be legitimate.

2. Rickettsia prowazekii da Rocha Lima (Berliner Klin. Wchnschr. 53:567-569, 22 May 1916) was also a validly published name applied to the same louse-borne pathogen. However, this name is antedated by more than a month by the name Stricheria jürgensi Stempel.

3. The generic name Rickettsia da Rocha Lima and the name of the type species R. prowazekii are quite universally accepted in medical and professional literature. Conversely the earlier name Stricheria Stempel based upon the species S. jürgensi has remained almost unrecognized and unused since its proposal. The strict application of the rule of priority in this situation would do major violence to Principle 1, Chapter 2 of the Code aiming at "fixity of names" and avoidance of throwing "science into confusion". It would also necessitate the replacement of the names of some of the supra-generic categories (higher taxa) such as the names of the family Rickettsiaceae and of the order Rickettsiales. The popular and widely used designation "rickettsiosis" for this group of diseases would doubtfully ever be replaced successfully by "stricheriosis" in the medical literature. Usage would seem unquestionably in favor of conservation of Rickettsia as against Stricheria.

4. The specific epithet prowazekii as used by da Rocha Lima in the

species name Rickettsia prowazekii has been almost universally recognized and used in microbiology rather than the older specific epithet jürgensi as proposed by Stempel in Stricheria jürgensi. It is contended that the displacement of the former specific epithet by the latter would cause much needless confusion.

5. The only argument in favor of exercise of priority in this instance would be that Stempel is entitled to recognition as the prior author to describe this important pathogen despite da Rocha Lima's independent and almost simultaneously published description. This is much outweighed by the adverse considerations above.

6. The Judicial Commission of the International Committee on Bacteriological Nomenclature is requested to take such action as may be appropriate to conserve the generic name Rickettsia da Rocha Lima against Stricheria Stempel, and to conserve the specific epithet prowazekii as used in the species name Rickettsia prowazekii da Rocha Lima against the specific epithet jürgensi as first used in the species name Stricheria jürgensi Stempel.

7. There is no question here that Stricheria jürgensi might equally apply to later described extra-cellular rickettsiae in human lice variously considered to be symbionts (R. pediculi Munk and da Rocha Lima 1917) and agents of trench fever (R. quintana Schminke 1917), names which accumulating information indicates are without much doubt synonymous (Bell and Philip, "The Human Rickettsioses", Annual Review of Microbiology, Stanford University Press, 1952 to be published).

Cornelius B. Philip
Hamilton, Montana

# BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY

## CONFERENCE ON VIRUS AND RICKETTSIAL CLASSIFICATION AND NOMENCLATURE

New York Academy of Sciences, Section of Biology
January 11 and 12, 1952

### A Resumé

R. E. Buchanan, Iowa State College, Ames, Iowa

The statement approved by the plenary session of the first International Congress of Microbiology at Paris in 1930 has historical significance:- "It is clearly recognized that the living forms with which the microbiologists concern themselves are in part plants, in part animals, and in part primitive." The need for adequate consideration of the problems of all phases of microbiological nomenclature was there recognized and emphasized. Later when the International Bacteriological Code of Nomenclature was approved at the fourth Congress at Copenhagen, the following wording was authorized:- "Bacteriological nomenclature considers bacteria, related organisms, and the viruses".

The nomenclature and taxonomy of the viruses have recently received increased attention. The plant pathologists interested in plant viruses have considered several systems of nomenclature proposed. The bacterial virologists have made tentative use of quite different systems. The animal virologists in many cases have felt that the time was not opportune for any definite action looking toward either classification or nomenclature of the animal viruses. It has become increasingly apparent that the three groups of virologists, those interested in the higher animals, in the higher plants, and in the bacteria have much in common. However, there was little opportunity for these groups to meet to discuss their common problems. The first major effort to coordinate thinking in the nomenclature was that of Holmes (1) who in 1939 in his Handbook of the Phytopathogenic Viruses proposed that all the viruses be placed in a separate group, the Vira, and that the Linnaean system of binomial nomenclature be applied. The classification was considerably expanded in Supplement 2 in Bergey's Manual of Determinative Bacteriology (ed. 6, 1948). All viruses were grouped in a single order, the Virales, with three suborders for the bacterial viruses, the plant viruses and the animal viruses respectively. A relatively elaborate classification of each suborder was developed, carried through to families, genera and species. Holmes' earlier classification (1939) of the plant viruses had considerable acceptance among plant pathologists and the binomial system was used by many authors of papers. However, some of those working in the field of the animal viruses felt that the treatment of these organisms by Holmes in

1948 was premature, and that great care needed to be used in preventing the straight-jacketing of the nomenclature in this group. It was suggested that some method should be worked out for withholding the final acceptance of all names until there had been an opportunity for the specialists carefully to review the field and to propose a system of nomenclature that would from the beginning have a high degree of acceptability and stability.

This widespread feeling on the part of animal virologists led to the organization through the International Committee on Bacteriological Nomenclature of a special Subcommittee on Viruses to meet with the fifth International Microbiological Congress at Rio de Janeiro in 1950. Dr. C. H. Andrewes of London was designated as chairman, and asked to select the members of such a committee. This he did, and the Committee held several meetings at Rio de Janeiro and made a series of recommendations to the International Committee on Bacteriological Nomenclature. These reports and recommendations have been summarized in previous issues of this BULLETIN (2, 3, 4). The final outcome of the Rio de Janeiro Congress with its attendant conferences was the enlargement of the work of Dr. Andrewes' Subcommittee on Viruses to make it representative of all of the major fields of virology. The Committee was asked to organize as a general Committee on Nomenclature and Taxonomy of the Viruses, with three sub-committees or Commissions representing each of the three subdivisions of the subject. Dr. Andrewes remained chairman of the Subcommittee on Virology and of the Commission on Animal Virology. Later Dr. L. M. Black of Brooklyn was designated as chairman of the Commission on Plant Viruses and Dr. J. Craigie of London as chairman of the Commission on Bacterial Viruses.

Lack of opportunity in the past for the several groups of virologists to meet to discuss their common problems led the New York Academy of Sciences through its Section of Biology to provide for an International Conference on Virus and Rickettsial Classification and Nomenclature, held in New York January 11 and 12, 1952. The conference was truly international in that many countries were represented and inclusive in that those interested in the most varied groups of viruses were in attendance.

Abstracts of about thirty papers and a complete copy of the address of the chairman Sir MacFarlane Burnet were issued as a preprint.

Several papers of general significance were followed by discussions of the problems of classification of various groups, including the rickettsias, the viruses of the higher plants, of insects, of the bacteria, and of higher animals, including such subgroups as the psittacosis, pox, influenza, arthropod borne, Coxsackie, poliomyelitis and encephalomyocarditis viruses.

## BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY

Several of the presentations had to do with general problems of nomenclature of classification and of speciation. Dr. Ernst Mayr of the Museum of Natural History in New York attempted to shed some light on the problems of taxonomy and nomenclature in the field of microbiology by consideration of species and taxon concepts developed in recent years in zoology, particularly in ornithology. His overemphasis upon the universality of sexual reproduction among living things, with the inference that real progress in systematic microbiology and virology can be achieved only when something is known of sexual recombinations in lower forms such as the bacteria and the viruses, left the listener with the distinct impression that the application of the standard rules of nomenclature to microorganisms not showing sexual reproduction was scarcely feasible. The suggestion was made that it might be well if the microbiologists and the virologists left the naming of their organisms to national or international committees. Dr. Burnet emphasized that the valuable developments in modern population genetics which have led to a better understanding of development and differentiation of species in the higher forms are quite without application in the great groups of agamic microorganisms. He formulated useful criteria to be used in the differentiation and classification of the viruses, and emphasized that the organisms cultivated in the laboratory often are quite different in certain characters from the organisms as found in the original host. With some proposed modifications he felt that the outlines of procedure formulated at the Rio de Janeiro Congress could well serve as guides.

Dr. Holmes' paper on the problems of nomenclature and classification emphasized some of the special difficulties that arise when virologists in the several fields of bacterial, plant and animal viruses attempt to compose their differences. Holmes, of course, believes that with suitable modifications the Linnaean binomial system of nomenclature is satisfactorily applicable to the viruses.

In a well-organized paper Dr. Andrewes (London) discussed the decisions reached by the Fifth International Microbiological Congress, and outlined the organization that had been evolved to insure orderly progress in the development of a report on nomenclature and taxonomy for presentation at the sixth Congress at Rome. It is apparent that Dr. Andrewes and the Committee on Virus Nomenclature and Taxonomy which he heads have a difficult task. Specifically Dr. Andrewes as chairman of a Commission to study one group of animal viruses has the task of organizing a report relative to its delimitation, subdivisions and nomenclature, further he has the task of coordinating the work of the several commissions of the animal virology subcommittee, and in turn attempting to formulate resolutions and suggestions that will be accepted by the plant virologists, the bacterial virologists and the animal virologists.

Much interest centered in the rather lively controversy as to whether the

Linnaean system of binomial nomenclature should either now or eventually be used in the naming of the viruses. Dr. Johnson of Wisconsin insisted that a numbering system for plant viruses of the type proposed by his committee at the Amsterdam Botanical Congress was preferable. Dr. Bawden of Rothamsted, England, made what appeared to many as a futile gesture to discredit the binomial system of nomenclature of viruses by ridicule. No poll was taken of the sentiment of the members of the conference as a whole, but the thinking of certain groups was quite clear. Those interested in the rickettsias seemed reasonably confident that a satisfactory binomial nomenclature in this group was largely developed and increasingly accepted. Similarly there seemed to be acceptance of binomial nomenclature by those working with the viruses of insects, even though stability has not been achieved as yet. The plant virologists were apparently divided as to their wishes. Some would develop numbering systems, some felt the binomial system inapplicable and inappropriate, but there was much evidence of increasing acceptance of the Linnaean system in the field of plant pathology. Dr. Andrewes stated that a questionnaire sent by him to plant virologists in many countries showed opinion to be rather evenly divided for and against the binomial system. One of the American workers pointed out that in a poll of plant virologists in the United States sentiment in favor of the binomial system was markedly predominant. No very definite expression was given by those working with bacteriophages. The problems in this group seem at present to be largely those of differentiation and classification rather than of nomenclature.

Sentiment among the animal virologists is rather more difficult to assess. There seemed to be no deepseated aversion to the use of the binomial system but it was fervently hoped that some method could be devised that would keep animal virology from being engulfed in a nomenclatural morass such as once threatened nomenclatural stability in bacteriology. Is it not possible in some way to fix upon names by means of an international agreement? Some were not averse to Mayr's proposal to have a suitable international committee fix names of taxa by fiat.

Several speakers emphasized that some groups of viruses are much better characterized than are others. Some groups may be readily broken down into genera and species, while others are still poorly described. A suggestion developed by Dr. Bitancourt of Sao Paulo met with some support. He pointed out a parallelism between the situation existing in the fungi and in the viruses. Scores of genera and thousands of species of fungi cannot be placed with certainty in the formal classification based largely upon the characteristics of the so called perfect stages and are allocated to the Fungi Imperfecti, a group created to include those forms whose perfect stage is unknown or has been completely lost from the growth cycle. The Fungi Imperfecti are divided into families, genera and species and the binomial system of nomenclature is applied. Whenever the

perfect stage of one of these "imperfect fungi" is discovered it may be placed in its appropriate genus and if necessary rechristened. It was proposed that a somewhat analogous scheme be adopted for the viruses. Those sufficiently characterized would be regularly designated by suitable binomials and the others placed in a group of viruses imperfectly known, and given tentative names with the expectation that when more adequate descriptions are available they would be transferred to their places in a logical system. Uncertainties as to classification in some cases could be recognized appropriately by the use of the common Latin phrase indicating uncertainty, there could be viral "Genera Incertae Sedis" as well as "Species Incertae Sedis". This procedure might give a usable nomenclature while more perfect taxonomic outlines were being developed.

Several of the papers had special nomenclatural implications. Dr. Black of the Brooklyn Botanical Gardens called attention to the existence of a special problem of classification in the more recently identified group of viruses in which multiplication occurs both in the plant host and in the insect vector. Four virus diseases of plants transmitted by leaf hoppers are known to belong to this group. Dr. Limasset of Versailles reviewed in detail the objections that have been raised to the binomial system of nomenclature as applied to the viruses and concluded that they are not serious and that some temporary difficulties might be resolved by use of the grouping "Vira Imperfecta"

Dr. Rake of the Squibb Institute for Medical Research concluded that certain viruses and rickettsiae are sufficiently well characterized to justify their being grouped into genera. The several criteria useful in the development of a classification of the bacterial viruses were outlined by Dr. Adams of New York University, including serological, morphological physical and physiological characteristics and the results of mixed infections. There are as yet no adequate criteria for the definition of bacteriophage genera, and the use of binomials may well be postponed until well characterized strains have been agreed upon as types, and a satisfactory method of maintaining and distributing such strains developed. Dr. Coles from his South African experience presented an incomplete classification of the rickettsias in which emphasis was laid upon morphology, serology, culture in eggs, the nature of the matrix etc. He recognized that a satisfactory classification and nomenclature must wait upon more complete understanding of the organisms. Dr. Philip of the Rocky Mountain Laboratory outlined a tentative classification of the Rickettsiales in which he recognized one family, three genera and three subgenera. Dr. Bergold of the Canadian Laboratory of Insect Pathology and Dr. Steinhaus of the University of California accepted in principle the binomial system of naming the insect viruses, but pointed out some of the present difficult problems both of classification and of nomenclature. The former suggested that some international committee might well be given some

degree of authority relative to the names finally to be accepted, a committee that could be consulted by investigators. Dr. Steinhaus listed two genera of insect viruses that seemed to be well established, together with their species, and with designation of the type species. Two other genera were included in the category of Genera et Species Incertae Sedis.

The problems to be solved relative to nomenclature of the several groups of animal viruses vary widely. Dr. Karl Meyer of the University of California posed the difficulties in the psittacosis-ornithosis group of large viruses and protested the unsatisfactory nomenclature. Dr. Rake of the Squibb Institute, New York, suggested that the lymphogranuloma-psittacosis group showed closer relationships to the rickettsiae than to the viruses. It is apparent from the reports given by Dr. Francis of the University of Michigan and by Sir MacFarlane Burnet of Melbourne, Australia that substantial progress is being made in an understanding of the influenza virus group and in eventual systematization of the nomenclature. Dr. Hammon of the University of Pittsburgh believes that there is insufficient knowledge of the arthropod-borne encephalitis viruses to make possible at present a rational use of the binomial system of nomenclature, and that the classification proposed by Holmes was premature. Dr. Lepine of the Pasteur Institute, Paris also discussed this group and indicated that substantial progress is being made. A suggested grouping of the arthropod viruses was noted, emphasizing that the several viruses appear to belong together although causing very distinct diseases and with distinct arthropod vectors. A suggested generic diagnosis for the Coxsackie viruses and diagnoses of two groups within the genus was presented by Dr. Dalldorf of the New York State Department of Health. He was able to differentiate ten types in the first group and three in the second. Dr. Malnick of Yale University pointed out certain difficulties in the acceptance of the two groups of Coxsackie virus as proposed by Dalldorf. A constructive criticism of the Holmes's classification of the poliomyelitis viruses was presented by Dr. Rhodes of the University of Toronto. The poliomyelitis group and criteria for diagnosis of a single genus with two or three species were discussed by Dr. Koprowski of the Lederle Laboratories, emphasis being laid upon morphology as determined by the use of the electron microscope. A schema for the encephalomyocarditis group was outlined by Dr. Warren of the Army Medical Service Graduate School, Washington.

The need of adequate and reliable type culture collections for the viruses was emphasized by several speakers. Dr. Smadel of the Army Medical Service Graduate School outlined the service of the Virus and Rickettsial Registry U.S.A., and Dr. McKinney the need for an adequate culture collection for the use of those interested in plant virology.

The last session of the Conference was devoted to an open discussion of the problems of virus nomenclature under the chairmanship of Sir Mac-

Farlane Burnet. The results of the conference and the papers presented are in process of publication by the New York Academy of Science. They will constitute a reference book of real value to all interested in the virus field and in its systematics.

In summary, it may be noted that Dr. Andrewes and his committee and commissions on virological nomenclature have the important task of preparing nomenclatural and taxonomic recommendations to be submitted to the next International Congress of Microbiology in September 1953. As far as practicable, virologists should take an active interest in the work of this committee and render all needed assistance. The task of the committee is complicated and difficult. Among its several assignments is that of making a definite proposal for a suitable date of departure for the nomenclature of the viruses. This fixing of a date is needed, no matter what form of nomenclature may be finally proposed or approved. There are many possible solutions to the problem. The deliberations of the conference and a survey of the actions that have been taken by international agreement in botany, zoology and bacteriology suggest the general nature of some of the possible solutions. To the reviewer, four seem worthy of mention.

1. The Committee might consider recommending that all names validly published in the literature of virology be regarded as available from the standpoint of priority (essentially the practice in most branches of biology).
2. The Committee might consider recommending that the starting point in virological nomenclature be some published monograph of the viruses, and all older names not therein recognized be ignored. Such an arrangement is in effect in botany for some groups of the fungi and of the algae. In the event of such a proposal, the monograph of Holmes would be among those to be considered.
3. The Committee might consider the advisability of preparing or of supervising the preparation of an authoritative monograph on the viruses, describing all the genera and higher taxa recognized, listing and naming the species accepted, and designating type species and type genera. Or the monograph might be definitive for certain of the better known groups of the viruses, with those not well known or indefinitely characterized placed in some such category as Vira imperfecta or Vira incertae sedis. Those organisms indefinitely placed would later be given recognized status when better characterized. Such a proposal would essentially be a recommendation for the conservation of a list of generic names with designation of the types.
4. The Committee may well find that the time available before the 1953 Congress is too limited to complete fully the task assigned. A recommendation that additional time be granted the Committee would doubtless be approved. It is to be hoped, however that substantial progress may have been made before any postponement is requested. There is rapidly

mounting pressure, certainly in America, for definitive action on virus nomenclature. A survey of recent literature reveals that binomial names for the viruses are increasingly employed and are accepted by a large proportion of the virologists. Obviously no author of a text which treats of the viruses, either of plants or animals, can ignore the names that are coming into use. It seems probable that the flood pressure may well be held under control until 1953 but it is to be hoped that the regulatory devices may be pretty well completed by that time.

# BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY

## INTERNATIONAL COMMITTEE ON BACTERIOLOGICAL NOMENCLATURE

### Members and Officers-1952

Provision 4 of the International Bacteriological Code of Nomenclature established a permanent International Committee on Bacteriological Nomenclature "so constituted that wherever practicable each country is represented by at least one member and no country by more than five. Nominations for membership are made preferably by one or more of the microbiological societies in each country." If nominations are not so made, they may be submitted by any member of the International Committee to one of the Permanent Secretaries. Acceptance will be indicated by the Permanent Secretaries, and ad interim membership given pending act on of the International Committee and the next International Congress of the International Association of Microbiologists.

A list of the officers and members of the International Committee on Bacteriological Nomenclature as approved at the Fifth International Congress of the International Association held at Rio de Janeiro, Brazil, in August 1950 was printed on the cover pages of each issue of the BULLETIN during the year 1951. That there were inaccuracies in the list was recognized. Corrections have been made insofar as they have come to light. Following is a list of the members of the delegations from the several countries as shown by the records of the Permanent Secretaries. Some addresses are unknown. The Permanent Secretaries will be grateful for information relative to any inaccuracies.

### OFFICE

Chairman

KLUYVER, Prof. A. J. - Technical High School, Nieuwe - Laan 5, Delft, Holland.

Vice-Chairman

PRÉVOT, Dr. A. R. - Institut Pasteur, 25 Rue du Dr. Roux, Paris XVe. France.

Permanent Secretary for Medical and Veterinary Bacteriology

COWAN, Dr. S. T. - National Collection of Type Cultures, Central Public Health Laboratory, Colindale Avenue, London N. W. 9 England.

Permanent Secretary for Non-Medical Bacteriology

WIKÉN, Prof. Torsten. - Inst. f. Bakteriologie u. Gärungsbiologie., Eidgenoss. Techn. Hochschule, Universitätstrasse 2, Zürich 6, Switzerland.

## MEMBERS OF COMMITTEE

### ARGENTINA

SORDELLI, Prof. A. - Posodas 1553, Martinez F. C. N. G. B. N., Buenos Aires.

SORIANO, Prof. Ing. Santos - Instituto de Microbiologia Agricola, Villa Orturar-Suc. 17, Buenos Aires.

### AUSTRALIA

MUNCH-PETERSON, Dr. E. - Div. Animal Health and Nutrition, Flemington Road and Park Street, Parkville, N. 2, Victoria.

RUBBO, Prof. S. D. - Department of Bacteriology, The University, Melbourne, Victoria.

SKERMAN, Prof. V. B. D. - Dept. Bacteriology, Medical School, Queensland University, Herston Road, Brisbane, Queensland.

### AUSTRIA

CHIARI, Prof. Hermann - Vorstand Pathologisch-Anatomisches Institut, Universität, Franzenring 6, Vienna 9.

EISLER-TERRAMARE, Prof. Michael - Staatl. Serotherapeut. Institut, Universität, Vienna 10.

JANKE, Prof. Alexander - Technische Hochschule, Waldeckgasse 3, Wien XVIII 110.

KRENN, Prof. Ing. J. - Lehrkanzel landwirtschaft. Mikrobiol., Gregor Mendelstr. 33, Vienna. 18.

SZYLVINI, Prof. Ing. - Institut für angewandte Mikrobiologie, Hochschule für Bodenkultur, Michaelstr. 25, Vienna 18.

### BELGIUM

BRUYNOGHE, Prof. Richard - Department of Bacteriology, University of Louvain.

RENAUX, Prof. Ernest - Faculté de Médecine et de Pharmacie, Université Libre de Bruxelles, 115 Boulevard de Waterloo, Brussels.

### BRAZIL

BITANCOURT, Dr. Agesilau - Instituto Biologico, Caixa Postal 7119 São Paulo, Estado de São Paulo.

CRUZ, Dr. Oswaldo, filho - Instituto Oswaldo Cruz, Caixa Postal 926, Rio de Janeiro, D. F.

DA ROCHA LAGOA, Dr. Francisco de Paulo - Instituto Oswaldo Cruz, Caixa Postal 926 Rio de Janeiro, D. F.

PENHA, Dr. Adolpho Martins - Instituto Biologico, Caixa Postal 7119 Sao Paulo (Estado de Sao Paulo).

PENIDO, Dr. J. C. N. - Instituto Oswaldo Cruz, Caixa Postal 926, Rio de Janeiro D. F.

## BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY

### BRITISH WEST INDIES

THAYSEN, Dr. A.C. - Director, Colonial Microbiological Institute, P.O. Box 584, Trinidad.

### BULGARIA

MARKOFF, Prof. W. - Dept. of Bacteriology, Univ. of Sofia, 3 Rue Dounau, Sofia.

PETROFF, Prof. T. - Department of Hygiene, University of Sofia, Sofia.

### CANADA

LOCHHEAD, Dr. A.G. - Division of Bacteriology, Central Experimental Farm, Ottawa, Ontario.

MORIN, Prof. E.J. - Dept. Bacteriology, Laval University, Quebec, P.Q.

MURRAY, Prof. E.G.D. - Dept. Bacteriology, McGill University, Montreal P. Quebec.

REED, Prof. Guilford B. - Dept. Bacteriology, Medical School, Queens University, Kingston, Ontario.

VAN ROOYEN, Dr. C.E - Connaught Laboratories, University of Toronto, Toronto 5, Ontario.

### CHILI

GRAF-MARIN, Dr. Alberto - Professor of Agricultural Microbiology, Universidad de Chile, Casilla 370, Santiago, Chile.

SAN MIGUEL, Dr. Julio - Faculdad de Ciencias Pecuarias y Medicina Veterinaria, Universidad de Chile, Casilla 370, Santiago.

VACCARRO, Dr. Hugo - Instituto de Microbiologia e Imunologia, Casilla 370, Santiago.

WILHELM, Dr. Ottmat - Prof., Universidad de Concepcion, Concepcion

### CZECHOSLOVAKIA

MALEK, Dr. Ivan. - Department of Bacteriology, University of Praha, Preslova 7, Praha.

RASKA, Dr. Karel - State Institute of Public Health, Srobárova 48, Praha III.

### DENMARK

BUCHWALD, Prof. Dr. N. Fabritius - Kgl. Veterinariog Landbohjskole, Bülowsvej, Copenhagen.

CHRISTIANSEN, Prof. M. - Serum Lab.; Veterinary School, Bülowsvej, Copenhagen.

KAUFFMANN, Dr. F. - Statens Seruminstitut, Amager Blvd. 80, Copenhagen S.

ØRSKOV, Dr. J. - Statens Seruminstitut, Amager Blvd. 80, Copenhagen S.

EIRE

GRIMES, Prof. Michael - Dairy Institute, University of Cork, Cork.

FINLAND

VARTIOVAARA, Dr. Unto - Dept. of Microbiology, The University, Helsinki.

FRANCE

HAUDUROY, Prof. Paul - Directeur du Centre de Collection de Types Microbiens, 19 Ave. César Roux, Lausanne, Switzerland.
LEPINE, Dr. P. - Institut Pasteur, 25 Rue du Dr. Roux, Paris XVe.
LWOFF, Dr. A. - Institut Pasteur, 28 Rue du Dr. Roux, Paris XVe.
PREVOT, Dr. A. R. - Institut Pasteur, 25 Rue de Dr. Roux, Paris XVe.
SEGRETAIN, Dr. G. - Institut Pasteur, 25 Rue du Dr. Roux, Paris XVe.

GERMANY

BOECKER, Prof. Dr. Eduard - Direktor Robert Koch Institut, Föhrerstrasse 2, Berlin 65.
HAUPT, Prof. Dr. Herbert -Veterinärhygienisches Institut, Frankfurterstrasse 87, Giessen.
MÜLLER, Prof. Dr. Reiner - Direktor, Hygienisches Institut, Fürst Pücklerstr., 56, Köln-Lindenthal.
SEELEMANN, Prof. Dr. M. - Institut für Milchhygiene, Hermann Weigmannstr 3/11 Kiel.
STAPP, Prof. Dr. C. - Direktor Biologische Zentralanstalt, 20b Braunschweig-Gliesmarode. Messeweg 25.

GREAT BRITAIN AND NORTHERN IRELAND

ANDREWES, Dr. Christopher H. - National Institute for Medical Research, The Ridgeway, Mill Hill, London N. W. 7.
MILES, Dr. A. A. - National Institute for Medical Research, The Ridgeway, Mill Hill, London N. W. 7.
RAMSBOTTOM, Dr. J. - British Museum (Natural History,) Cromwell Road, London S. W. 7.
WILSON, Dr. G. S. - Public Health Laboratory Service, 38 Old Queen Street, Westminster, London S. W. 1.

HUNGARY

MANNINGER, Prof. R. - Director, State Veterinary Hygienic Institute, Hungária Körut 23-26, Budapest XIV.

ISRAEL

ASCHNER, Dr. M. - Dept. Bacteriology, Hebrew University, Jerusalem

## BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY

### ITALY

ARNAUDI, Prof. Carlo - Instituto di Microbiologia della Facoltà di Agraria, Università di Milano, Via Celaria, Milan.
CIFERRI, Prof. R. - Instituto Botanico, Università di Pavia, Via Scopoli, P.O. Box 165, Pavia.
DE ROSSI, Prof. Gino. - Via Buccari 3, Rome.
PENSO, Dr. G. - Instituto Superiore di Sanità, Viale Regina Margherita 299, Rome.
PUNTONI, Prof. V. - Instituto d'Igiene, Università Roma, Rome.

### JAPAN

ASAI, Prof. Dr. Toshinobu - Faculty of Agriculture, Univ. of Tokyo, Mukogaoka-Yayoimachi, Bunkyo-ku, Tokyo.
KOJIMA, Dr. Sabura - Director of the National Institute of Health, 1, Shiba-Shirokane-Daimachi, Minato-ku, Tokyo.
KOMINAMI, Dr. Kiyoshi - Nagao Research Institute, 387, 6, Cho-me, Kitashinagawa, Shinagawa-ku, Tokyo.

### NETHERLANDS

JULIUS, Prof. Dr. H.W. - Laboratorium voor Hygiene, Univ. Utrecht, Catharijnesingel 59, Utrecht.
KLUYVER, Prof. Dr. A.J. - Technical High School, Nieuwe Laan 3, Delft.

### NEW ZEALAND

BUDDLE, M.B., (B.V.Sc.) - Wallaceville Animal Research Station, Private Bag. Wellington.
KIRSTNER, Dr. L. - Medical School, University of Otago, Dunedin, Cl.
WHITEHEAD, Dr. H.R. - Dairy Research Institute, Massey College, Palmerston North.

### NORWAY

HENRIKSEN, Dr. S. Dick - Statens Institutt for Folkehelse, Geitmyrsvegen 75, Oslo.
THJØTTA, Prof. Th. - Bacteriological Institute, University of Oslo, Oslo.
VOSS, Prof. J. - State Institutt for Folkehelse, Geitmeyrsvegen 75, Oslo.

### POLAND

LEGEZYNSKI, Prof. St. - Department of Bacteriology, State Institute of Hygiene, Chocimska 28, Warsaw.
PRZESMYCKI, Prof. F. - State Institute of Hygiene, Chocimska 28, Warsaw.
SZYMANOSKI, Prof. Dr. F. - Dept. of Bacteriology, The University, Lodz, Poland.

RUMANIA

IONESCU-MIHAIESTI, Prof. Dr. C. - Faculty of Medicine, Splaiul Dr. Carol Davilla 6, Bucharest VI.

ZOTTA, Prof. Dr. G. - Splaiul Dr. Carol Davilla 6, Bucharest VI.

SPAIN

FALCO, Dr. A. Ruiz - Instituto Nacional de Hygiene, Madrid.

SWEDEN

GARD, Prof. Sven - State Bacteriological Laboratory, Karolinska Institutet, Box 764, Stockholm 1.

HULPHERS, Prof. Gustav - Dept. Bacteriology, Veterinary College, Stockholm.

NILSSON, Prof. Ragner - Kungl. Lantbrukshogskölan, Uppsala.

SWITZERLAND

DOERR, Prof. R. - Hygienisches-Institut der Universität, Basel.

FREI, Prof. W. - Veterinär-Pathologisches Institut, University of Zürich, Zürich.

UNITED STATES OF AMERICA

ALLEN, Dr. Oscar N. - Department of Bacteriology, University of Wisconsin, Madison 6, Wisconsin.

BROWN, Dr. J. Howard - 1640 Gorsuch Avenue, Baltimore 18, Maryland.

BUCHANAN, Prof. R. E. - Room 24 Curtiss Hall, Iowa State College, Ames, Iowa.

VAN NIEL, Prof. C. B. - Hopkins Marine Station, Pacific Grove, California.

URUGUAY

HORMAECHE, Prof. E. - Instituto de Higiene, Faculdad de Medicina, Av. A. Ricaldoni, 3051, Montevideo.

U.S.S.R.

HOROWITZ-WLASSOWA, Prof. - 1 Linia, 54, App. 3, Leningrad 53, W.O.

ISSATCHENKO, Prof. Dr. B. - Institute of Experimental Medicine, 96 Baltiiskii poselok 13, Moscow 96.

LIFE MEMBERS

ST. JOHN-BROOKS, Dr. Ralph - Department of Bacteriology, Trinity College, Dublin, Ireland.

BREED, Prof. R. S. - 6 Sunset Drive, Geneva, New York, U.S.A.

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